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THE UNIVERSITY OF ALBERTA

THE RELATIONSHIP OF
THE LAYCOCK MENTAL ABILITY TEST TO SUCCESS
IN HIGH SCHOOL

A DISSERTATION
SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF ARTS

FACULTY OF ARTS AND SCIENCE
DEPARTMENT OF PHILOSOPHY AND PSYCHOLOGY

by

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EDMONTON, ALBERTA,

MARCH 31, 1954.

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The undersigned hereby certify that they have
read and recommend to the School of Graduate Studies
for acceptance, a thesis entitled

THE RELATIONSHIP OF THE LAYCOCK MENTAL ABILITY TEST
TO SUCCESS IN HIGH SCHOOL

submitted by Harold Edward Panabaker
in partial fulfilment of the requirements for the
degree of Master of Arts.

PROFESSOR.

PROFESSOR.

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Date...12 April, 1954....

SYNOPSIS

This study is an investigation of the relationship between scores obtained on the Laycock Mental Ability Test in junior high school and subsequent achievement in senior high school. The subjects are 769 Calgary students who entered Grade X in September, 1946. Correlations were obtained between the test and all marks available for Grades X, XI, and XII, except for the general and vocational courses in Grade XII. The breaking up of the students into groups according to the courses they selected and the dropping out of many of them before they completed high school reduced considerably the numbers studied in certain courses, especially at the senior level.

The relationship between the I.Q.'s obtained on this test and school marks was found to be significant and positive for almost all the academic subjects at all grade levels in the high school. The correlation co-efficients ranged from .17 to .66 . Few significant relationships were discovered between Laycock I.Q.'s and marks on the vocational and general subjects.

Students were classified into three groups on the basis of I.Q. as follows: Group I, I.Q. 120 and up; Group II, I.Q. 100 to 119; Group III, I.Q. be-

low 100. A marked difference in favor of the higher I.Q. groups was observed in the percentages of the groups meeting the four different criteria of high school success; Honors standing, A standing, University Entrance Level, B standing. The difference was most marked when the most severe criterion was used and was consistent for the academic subjects. In the case of the vocational and general subjects, no consistent difference was found between these groups.

Because the relationships discovered are similar to those revealed in other validation studies and because of the difference in the achievement of the groups mentioned above, the study tends to establish the validity of the Laycock Mental Ability Test. With regard to the academic subjects, it has satisfactory predictive value for groups, but little for individuals. It has practically no value for predicting success in non-academic courses. Because the criteria of success used in this study, that is, the grades awarded by the Department of Education on the terminal examinations, are based upon the normal curve, they are not independent of student achievement, the general predictive value of the test is lowered and no conclusions can be drawn respecting a minimum critical score necessary for success at any level.

ACKNOWLEDGEMENTS

Grateful acknowledgements are made to those whose assistance brought this project to completion. To the Calgary School Board and the Examinations Branch, Department of Education, Province of Alberta, for making the necessary records freely available. To my daughter Helen for her many hours of painstaking work transcribing the data from school board and departmental records. To Mr. W. Hugh Broadberry, who read the rough draft and offered valuable suggestions for its improvement. To Professor Douglas E. Smith, who was my adviser for graduate studies and whose wise counsel and discerning criticism have been invaluable not only in carrying out this project but also in all the other work associated with the program. And, finally, to my wife, who, during the past year, has borne with patience the isolation and curtailment of social life which the project imposed and who has at all times encouraged me to keep at it, especially when the pressures and distractions of other duties and responsibilities could very easily have caused me to neglect it.

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INTRODUCTION

This study arose out of the necessity to determine the validity of the Laycock Mental Ability Test for the prediction of success in high school. The writer, having the responsibility for the guidance program in a city school system, found that teachers and teacher-counsellors tended to make rather drastic prognoses, particularly of failure, on the basis of I.Q.'s obtained on this test. It was, therefore, of considerable practical importance to him to determine the degree to which they were justified in using the test in this way.

In addition to this very practical consideration was the fact that practically no studies had been made of this test, which is rather widely used in Western Canada. At the time the study was begun, the writer was assured by Dr. S. R. Laycock, author of the test, that he knew of no validation studies undertaken at the University of Saskatchewan. A request asking for information of other investigations was inserted in the Canadian Psychological Journal without results. Consequently the study seemed justifiable on two counts, theoretical and practical. It would yield

some new information of value to users of the test;
and it would have some important practical applicat-
ions in relation to the writer's own organization.

CHAPTER I
SURVEY OF THE LITERATURE

In the validation of any test, the results obtained from its use must be compared with the application of some other criterion of the behavior the test is designed to measure. In the case of an intelligence test, the criterion measure may be another intelligence test which has previously received rather general acceptance as a valid measure of intelligence, or it may be some other measure such as school marks, which have long been accepted as rather good indicators of mental ability. Thus, many authors of intelligence tests claim validity for their creations on the basis of their high correlation with the Revised Stanford-Binet Intelligence Scale or with school marks or both. The usual procedure is to quote a validity co-efficient to establish the claim. Greene (7) points out that "a high correlation is no conclusive proof of validity, for a test may be measuring some pattern of behavior which is not the same as its criterion, yet which happens to be highly correlated with it in the group tested." His warning loses its significance if large enough and representative enough groups of subjects are involved in the comparison, for if the correlation is sufficiently high the measurement of the one trait can provide the basis for a very good

estimate of the other. It is, however, important to keep it in mind in every study in which one attempts to determine the validity of one measure by comparing it with another and totally different one. The same author also states that a "low validity correlation does not necessarily mean that the test is qualitatively invalid. A low correlation means that prediction of one variable from the other is poor." (7)

On the general question of validity, Bennett (1) makes the following interesting and pertinent observation: " In short, validity is specific. There is no 'validity of a test' - only empirical 'validities' derived from the use of the test in numerous situations. Out of the mass of data, generalizations emerge regarding the usefulness of the test. Validation is a never ending process. The test user himself must evaluate and integrate all the data available to him. As experience accumulates, the separate test scores take on increased meaning as measurements of human abilities."

Garrett (5) states : "Though admittedly fallible - if they were not we should not need intelligence tests - school marks constitute our best single criterion of that kind of intellectual activity which intelligence testers since Binet have attempted to measure. If our

tests measure something radically different from that ability measured by school marks, then they are not useful estimates of the intellectual ability of school children, no matter what their discriminative capacity."

Bovee and Froelich (2) report correlations of .46 and .45 respectively between scores on the Revised Stanford-Binet and end-of-the-year performance on the Co-operative French Test for 279 First Year and 172 Second Year students in the University of Chicago Laboratory School. They also report gross discrepancies in individual cases.

After studying 3852 boys in all phases of post-primary education in Belgium, Mortier (14) concluded (a) that each form of education requires minimum mental levels; (b) that the most important reason for failure is inadequacy of mental level; and (c) that in prediction, the intelligence test has preponderant importance.

Wheeler (21) found a correlation of .70 between reading and the A.C.E. "L" score, .36 between reading and the A.C.E. "Q" score, and .71 between reading and the A.C.E. Total score.

Lennon (12) reported the correlation between community mean Pintner I.Q. and community mean standard score on the Metropolitan tests as .85 for Grade VIII

reading and .84 for Grade IX reading with considerably lower correlations for spelling and arithmetic. The fact that the correlations were of community mean scores on both tests probably ensured that higher correlations than usually are reported would be found.

For 27 junior high school pupils, Kvaraceus (10) and Lanigan found a correlation of .59 between scores on the Otis Quick Scoring Mental Ability Test Beta and sub-test scores in arithmetic on the Iowa Every-Pupil Test of Basic Skills. For the Otis Beta and reading comprehension the correlation was .78.

Eysenck (6) found correlations of intelligence scores with college marks of .50 to .60, with somewhat higher correlations when objective tests of achievement were used.

Townsend (20) reported a correlation of .617 for A.C.E. scores and spelling.

Sorenson (18) states: "In general there is a correlation of .40 to .50 between I.Q. and college achievement."

Woodworth (23) claims that "correlations between I.Q. and school work go down from .75 in the lower grades to .60 - .65 in the secondary school and to .50 in college."

After discussing the relationship between

intelligence and educational achievement, Super (19) states; " Despite the relationship.....revealed by data such as the above, the correlation between intelligence tests and grades is not especially high. The numerous summaries of the subject show that in high school they tend to range from .30 to .80 and in college from .20 to .70, the modal r 's being .40 and .50 in the former and between .30 and .50 in the latter."

The Encyclopedia of Educational Research (13) summarizes a number of studies and reports on this general problem. It gives correlations between tested intelligence and school achievement that range from .18 to .72 with median r 's of from .45 to .50.

Greene (7) states: "Prediction of general scholastic average from a group verbal intelligence test is usually near .70 for elementary school groups but considerable lower for high school and college."

In a review of the Pintner General Ability Tests (3) Marzolph reports that the test manual gives correlations of from .59 to .84 with scores on achievement tests at various levels.

Ferguson (4) included the following statement in his review of the Ohio State University Psychological

Test:

"This test emphasizes verbal ability which is of undoubted importance in scholastic achievement. My impression is that the authors have approached a limit in prediction possible with this type of material..... A correlation of .70 with a criterion, which is high for tests of this class, still leaves about 50 per cent of the criterion variance unaccounted for. The technology that has evolved around the construction and use of mental tests, however rigorously applied, can carry us only so far in the prediction of human behavior. Progress in this area will to a considerable extent depend on the development of new types of tests which define properties of human behavior radically different from those defined by many of the more widely used types of tests."

Guildford (3) commenting on the same test gives the opinion that "in spite of the unusually high validity co-efficient, which probably rests on the fact that verbal ability is by far the greatest contributor to average scholastic achievement as measured, it is time to question whether other qualities that are really important, particularly in the more specialized curricula and courses should not receive more consideration.....It is time for us to think more in terms

of academic aptitudes than of academic ability."

All the foregoing comments apply to the so-called general intelligence tests. During the past few years considerable emphasis has been placed upon the measurement of primary mental abilities or specific aptitudes. The publishers of the Differential Aptitude Tests (1) have included the results of many validation studies in the manual accompanying the tests. The correlations reported for various school subjects and the different tests comprising this battery range from 0 to .75 approximately, with few above .65.

On the general problem of prediction, the Encyclopedia of Educational Research (13) remarks: "A study by Ames is indicative of the factors which operate to reduce the predictive value of group intelligence tests. She studied groups of high school students who had intelligence quotients below the average of their classes but whose achievement was higher than the average. She obtained a multiple correlation of .71 between achievement and intelligence test scores combined with teachers' ratings of persistence and school attitude. She also found that success in school achievement was related to ability to succeed socially and to conform to the school pattern."

Further to this problem, Super (19) warns against the common error of using test scores, or any other single measure for that matter, as the basis of a rigid or dogmatic prediction. In his view, the term "predict" is more or less synonymous with "estimate" and "a best estimate is merely a statement of probability." With this view the writer concurs. No prediction of success based upon the score on an intelligence test can ever be more than a statement that the subject is probably bright enough to succeed in some course or to perform some task satisfactorily. The many factors, other than those measured by the test, which determine the final performance of the individual reduce the prediction to a mere statement of probability.

It appears from the foregoing that when scores obtained from group tests of intelligence are correlated with school marks at different levels, the resulting co-efficients range from .18 to .85 . For secondary schools and universities, correlations of the order of .70 are considered high. According to Ferguson (4) and Guildford (5) the verbal tests, of which the Laycock Mental Ability Test is an example, lack validity as predictors of success in specialized courses.

CHAPTER II

THE PURPOSE OF THE STUDY

In Calgary the Laycock Mental Ability Test (11) has been administered to Grade VI and Grade VII pupils during the last fifteen or more years. Since 1946 it has been given regularly to all Grade VII pupils and to those in Grades VIII and IX for whom test scores are not available or for whom another measure is desired. The junior high school counsellors give considerable weight to the test scores when discussing the choice of high school programs with Grade IX students. Some of them doubtless use rather highly directive methods to persuade students to choose courses in line with their abilities as revealed by the test scores and their school marks.

The questions which the study attempts to answer are these:

(1) How are the I.Q.'s obtained on the Laycock Mental Ability Test in junior high school related to subsequent performance in junior high school, and, a somewhat different statement of the same question, to what degree can this test be used to predict success in high school?

(2) Is there on this test a minimum I.Q. for success in high school?

CHAPTER III

OUTLINE OF THE STUDY

The entire group of Calgary students entering Grade X in September 1946 was selected for the study. Laycock test scores were available for 769 of these students. A total of 1112 students registered in Grade X in the three Calgary high schools that year. The difference includes a considerable number of students from adjoining rural areas as well as those from the city for whom no test scores were available.

It was planned to obtain all the marks for all the students and correlate them course by course and grade by grade with the Laycock I.Q.'s. This proved impossible, however, as the records showing the marks awarded in Grades X and XI were not available for all three schools. It was possible to secure letter gradings but this did not appear to be wise as the letter grades represent broad categories of marks as follows: H, 80 to 100; A, 65 to 79; B, 50 to 64; C, 40 to 49; D, 0 to 39. The differences in the ranges made it inadvisable to assign numerical marks for purposes of correlation. Only the marks available for each grade were used. As will appear later, this resulted in lowering the mean I.Q. considerably for Grades X and XI, especially for Grade XI. However, for Grade XII, the examination records were consulted so that all of the original group who proceeded that far were included.

As the Department of Education sets provincial examinations at the end of Grades IX and XII, the writer considered omitting all the marks obtained in Grades X and XI on both academic and non-academic subjects. However, it was decided to include them to see if any regular relationship, even allowing for the poor sampling, existed between student I.Q. and marks obtained in these grades and to what degree the relationship varied for non-academic and academic courses. Non-academic courses were not included for Grade XII, as the number of students continuing them into this grade was too small to justify drawing any conclusions.

This study, then, starts with a large and rather representative sample of the high school student population which, for certain years and for certain courses, is considerably reduced by accidental factors. The inadequacy of records has already been referred to. Another factor must be noted. The selection of courses in high school by these students may or may not have been typical of all students entering high school. No attempt was made to discover what pattern their choices followed. Another point to be observed is that as the group becomes segmented into various sections and courses the populations for which the r 's are obtained are by no means identical. For some courses the number of

cases is too small. Consequently, it may be a serious limitation, not to say defect, of this study that such an approach was used.

The attempt to see if a regular relationship exists between student I.Q. and school marks may succeed only in a general way. It is at least arguable that a correlation of .53 for 769 students in Grade IX mathematics is not rightly to be compared with one of .25 for 243 of those students in Grade XII Algebra. The elimination from the first group of the 526 students who did not write Grade XII Algebra may affect the correlation very materially. To partly investigate this problem, separate correlations were obtained for those Grade IX students in English, French, General Mathematics, and General Science who subsequently wrote Grade XII English, French, Algebra, and Physics or Chemistry, though no attempt was made to discover the final answer.

CHAPTER IV

THE LAYCOCK MENTAL ABILITY TEST

This test was copyrighted by S.R. Laycock (11) of the University of Saskatchewan in 1933. It was designed for use in Grades IV to X. The test manual states: "This test is constructed on the basis of Spearman's theory of the nature of intelligence as set forth in his volumes 'The Nature of Intelligence' and 'The Abilities of Man'. It aims, therefore, to measure Spearman's factor 'g'. And since tests involving education of relations and education of correlates have been shown to be highly saturated with 'g', only tests involving such educative processes have been used." As was stated earlier, it is not the purpose of this study to examine the theory of intelligence on which this test is based. The quotation is given merely to show what the test author had in mind.

The test consists of seven timed sub-tests: Classification, Analogies, Analogies - Drawings, Opposites, Inferences, Number Series, Completion.

Test 1, $3\frac{1}{2}$ minutes, Classification, requires the subject to underline the one word most unlike the other three in groups of four. There are thirty groups ranging in difficulty from "plate, saucer, cup, pie" to "disfavor, disapprobation, condemnation, dishonor."

Test 2, $4\frac{1}{2}$ minutes, Analogies, presents thirty analogies ranging from "Dog is to pup as cat is to - mouse, rat, dog, kitten," to "Evolution is to revolution as crawl is to - baby, stand, run, creep." In each case, the subject is to underline the correct word in the last four.

Test 3, 2 minutes, Analogies - Drawings, presents the subjects with ten questions in which he must discern the relationship between two drawings and then find a similar relationship between a third drawing and four others.

Twenty-eight items are included in Test 4, Opposites, time: 4 minutes. The first item reads: "Fat is most nearly the opposite of - tall, thin, big, high." The last item is: "Unless is most nearly the opposite of - and, therefore, if, also."

The first of the twelve items in the six-minute Test 5, Inferences, is "A farmer grows less wheat than oats and more barley than oats. Which does he grow the most of? Barley, none, wheat, oats." The twelfth one reads: "Harry Smith and George Brown are my first cousins but they are not related to each other. My mother was Miss Brown before she was married. My father had no brothers. Harry's mother's name before she married was Bell. What is most likely to be my name? Smith, Brown, Bell, none of these."

In Test 6, $8\frac{1}{2}$ minutes, Number Series, the subject adds two numbers to a series of six numbers. The thirty items range from simple arithmetic progression to more complicated series involving two or more progressions simultaneously.

Test 7, 4 minutes, Completion, requires the subject to underline the best of four possible completions for sentences ranging in difficulty from: "The boy could not reach the top shelf because he was too - tall, short, big, old," to "Subservient people are apt to be - aristocratic, conceited, proud, deferential."

Under the heading of validity the manual gives the correlations listed below for the criteria named.

CRITERIA	r	N
Teachers' judgements (10 classes)	.42 - .86 (Median .67)	329
School Marks (10 classes)	.42 - .71 (Median .57)	304
Terman Group Test of Mental Ability	.78	38
National Intelligence Test	.80	37
Otis Self-Administering Test of Mental Ability	.81	24
National Intelligence Test	.90	28

From time to time during the past several years the writer has made comparisons of the Laycock Test with others. These are reported here so that they may be compared with the figures from the manual.

In 1946, this test was compared with the Otis Quick Scoring Mental Ability Test, Gamma. The subjects were 72 students comprising the two Grade IX classes in McDougall School Calgary. The teachers of these classes were asked to give an estimate of their abilities. The following results were obtained.

	OTIS	LAYCOCK
Mean I.Q.	103.8	109.5
Standard Deviation	7.65	9.4
Range	85118	83127

Correlations

Laycock with Otis	.79
Laycock with Teachers' Estimate	.68
Otis with Teachers' Estimate	.61

In 1951 the Laycock Test was compared with the S.R.A. Classification Form (Verbal) for a group of 401 Grade VII students. The S.R.A. Classification Form gives three I.Q.'s: a "Q" or Quantitative I.Q., an "L" or Linguistic I.Q., and a Total I.Q. These results were obtained:

Laycock I.Q. and S.R.A. "Q" I.Q.	.65
Laycock I.Q. and S.R.A. "L" I.Q.	.57
Laycock and S.R.A. Total I.Q.	.75
Laycock I.Q. and Marks in Social Studies-Language Courses	.58
Laycock I.Q. and Marks in Mathematics- Science Courses	.58
S.R.A. Total I.Q. and Social Studies- Language Marks	.52
S.R.A. Total I.Q. and Mathematics- Science Marks	.51

For several years the Alberta Department of Education used the Henmon-Nelson Test of Mental Ability as the "General Test" in the Grade IX departmental examinations. In 1952, the correlation of the I.Q.'s obtained on this test and those on record for the Laycock Test for 1120 Grade IX students was .79 .

The relationships just given are of the same order as those quoted earlier from the manual of the Laycock Test and, if correlation with other tests is a criterion of validity, tend to substantiate Laycock's claims. However, the great similarity between the items in various group tests of intelligence makes it almost inevitable that large groups of subjects will achieve substantially similar results on most

of these tests. The fact that this is the case, while establishing the relationship between the measurements obtained, does nothing to prove that the particular test under review or, indeed, any of them actually measures intelligence. The selection of a criterion must be related to the theory of intelligence which the test maker holds. But pursuit of that argument will take us far beyond the scope of this paper. It is, therefore, abandoned.

For many years the students writing the Grade IX departmental examinations were graded H, A, B, C, and D, H being honors standing and D, failure. In 1949, the writer analysed the results of the examinations to discover what differences in Laycock I.Q.'s were represented by these categories. Records for 954 students were examined with the results shown in Table I. Except for the difference between the means of the two lowest categories, the differences between the means of adjacent categories are highly significant.

Table II shows how, except for categories C and D, 80 per cent of the students in one category possess higher ability as measured on the Laycock Test than all but approximately 40 per cent of those in the next lower category. It also shows the almost complete overlapping of categories C and D. It is obvious that students with

TABLE I. RANGE, MEAN, AND STANDARD DEVIATION OF LAYCOCK MENTAL ABILITY TEST I.Q.'S OF STUDENTS SECURING GRADES AS INDICATED ON THE GRADE IX DEPARTMENTAL EXAMINATIONS, JUNE 1949.

GRADE	N	I.Q. RANGE	I.Q. MEAN	I.Q. STANDARD DEVIATION
H	87	107 - 154	126.6	10.6
A	353	90 - 146	115.5	9.7
B	300	71 - 130	104.3	10.1
C	146	56 - 114	94.3	10.7
D	68	74 - 114	92.4	8.6
Whole Group	954	56 - 154	108	14.3

the highest Laycock I.Q.'s tended to secure the highest grades on this examination. Other analyses conducted by the writer with equally large numbers of students show the Laycock I.Q.'s to fall consistently into the distribution shown in Table II. (16) These data tend to support Laycock's claim that the test does differentiate the more able from the less able students.

TABLE II. PERCENTILE DISTRIBUTION OF LAYCOCK M.A.T.
I.Q.'S OF 954 CALGARY STUDENTS AS CLASSIFIED INTO
CATEGORIES H, A, B, C, and D ON THE DEPARTMENTAL
EXAMINATIONS, JUNE 1949. (GRADE IX)

%ile	H	A	B	C	D	WHOLE GROUP	%ile
97	150	134	125	116	109	135	97
90	140	128	118	109	104	126	90
80	136	124	112	103	99	120	80
70	131	120	109	99	97	116	70
60	128	118	106	97	95	112	60
50	126	115	104	94	93	108	50
40	123	113	102	92	91	104	40
30	121	111	99	89	88	100	30
20	117	107	95	85	84	95	20
10	112	102	91	80	80	90	10
3	106	94	83	72	73	81	3

CHAPTER V

PROCEDURE

The records of all Calgary students writing the Grade IX examinations in 1946 were examined to discover those for whom Laycock Test scores were available. Of this group those who registered in Grade X the following term were included. A form, shown in Appendix A, was used to record each student's marks in all subjects taken during his high school career. As the study progressed and the previously mentioned difficulty with records arose, it was decided to utilize only those marks that were available.

One result of the unavailability of some of the Grade X and XI marks has already been mentioned, namely, the reduction of the mean I.Q. at these levels except for the academic electives. The group left is not truly representative of the total Grade X and XI class because of the omission of many academic students who scored high on the Laycock Test. Conclusions drawn from the data in the study for these two grades can only be highly tentative. Table III shows how the mean I.Q. rises from 110 in Grade IX to 113. in Grade XII (the compulsory subjects of English and Social Studies indicate this). However, these same subjects show a mean I.Q. of 109.0 for Grade X and 107. for Grade XI.

In 1952 the Principal of one of the Calgary high schools reported to the writer the median Laycock I.Q.'s for the Grade X academic, commercial, and technical groups in his school as 113, 107, and 100 respectively. The academic students concerned need not take technical electives in their programs, but for the school from which the figures for technical and commercial subjects included in this study were received, such is not the case. There all students must carry at least one commercial or technical course in each of the first two years of high school. Consequently the mean I.Q. of the students in the technical and commercial courses shown in Table III is above the median just referred to.

Commenting on the fact that differential curricula have been found to attract or require different degrees of intelligence, Super (19) reports a nation-wide American study by Kefauver which gave the median I.Q. of high school boys in different courses as follows:

College Preparatory	114
Academic	106
Commercial	104
Technical	92

The test used is not indicated; neither is the exact nature of the curricula. In the present study, the

term "academic" means "college preparatory". Allowing for differences in definitions and in the test used, it appears that the Calgary medians reported above are reasonably close to those found by Kefauver.

As the study progressed the following rules of procedure were arbitrarily established:

(a) If a student repeated a course or wrote a supplemental examination, only his first mark in that course was admitted.

(b) Algebra 1 and Physics 1 were commonly taken in Grade X. Some students, however, took one or other of these courses in Grade XI, sometimes after taking General Mathematics or General Science. Marks obtained in Algebra 1 and Physics 1 in Grade XI were excluded.

(c) Three sets of averages were used; average language-humanities; average mathematics-science; and general average. None of these averages was computed unless at least two marks were available.

For average language-humanities: social studies and one of English, French, or Latin.

For average mathematics-science: at least one mathematics and one science.

For general average: at least one from the language-humanities section and one from the mathematics-science section.

(d) Some students completed their high school programs in three years; but a number of academic students in the one composite high school represented in the study required four years because the inclusion of the technical course required in that school prevented their securing enough matriculation courses to complete the university entrance program in three years. All Grade XII students were grouped together regardless of whether they took three or four years to complete the program. The writer felt that the reasons for not including marks on Physics 1 and Algebra 1 which were obtained in Grade XI did not apply to Grade XII. All students had received instruction in the prerequisite courses; the effect of the difference between three or four years in high school was assumed to be negligible.

TABLE III. PEARSON PRODUCT MOMENT COEFFICIENTS OF
CORRELATION OF LAYCOCK MENTAL ABILITY TEST I.Q.'S
WITH MARKS IN VARIOUS SUBJECTS GRADE IX TO GRADE XII.

SUBJECT	r	N	r/σ_{r_0}	MEAN		SIGMA	
				MARK	I.Q.	MARK	I.Q.
GRADE IX							
English	.60	769	16.6	60	110	17	12.2
Social Studies	.50	769	13.8	66	110	19	12.2
French	.38	605	9.3	67	111	15	12.2
Aver. Lang- Humanities	.59	769	16.3	63	110	14	12.2
Mathematics	.53	769	14.6	55	110	21	12.2
Science	.49	768	12.9	64	110	20	12.2
Aver. Math.- Science	.58	768	16.0	60	110	18	12.2
General Average	.64	769	17.7	62	110	14	12.2
. HIGH SCHOOL ACADEMIC							
GRADE X							
English	.45	641	11.3	59	109	14	12.2
Social Studies	.37	641	9.4	62	109	13	12.2
French	.35	277	5.8	56	113	18	10.8
Latin	.28	85	2.5	57	114	19	11.3
Aver. Lang.- Humanities	.43	641	10.8	57	109	12	12.2
Algebra	.33	381	6.4	56	113	19	11.1
Physics	.33	257	5.3	58	114	14	11.2
Aver. Math.- Science	.36	247	5.6	57	114	14	11.3
General Aver.	.39	390	7.6	57	113	12	10.9

TABLE III (CONTINUED)

SUBJECT	r	N	r/σ_{r_0}	MEAN		SIGMA	
				MARK	I.Q.	MARK	I.Q.
GRADE XI							
English	.31	291	5.3	50	107	14	11.8
Social Studies	.29	292	4.9	53	107	12	11.7
French	.30	75	2.5	57	113	16	9.5
Latin	.45	10	1.3	73	116	16	9.2
Aver. Lang.- Humanities	.35	290	5.9	50	110	12	11.9
Geometry	.38	121	4.7	55	112	20	10.0
Chemistry	.45	28	2.3	53	109	19	10.5
General Average ⁽¹⁾	.41	124	4.5	53	111	13	10.6
.							
GRADE XII							
English	.66	407	13.2	60	113	14	11.4
Social Studies	.51	406	10.2	60	113	14	11.5
French	.28	155	3.4	55	116	14	10.5
Latin	.24	70	1.9	59	120	16	10.5
Aver. Lang.- Humanities	.55	395	10.8	58	113	12	11.4
Algebra	.25	243	3.9	52	116	17	10.1
Trigonometry & Analytical Geometry	.22	213	3.2	53	117	16	10.4

(1) Because of the small number in Chemistry the Mathematics-Science Average was not calculated.

TABLE III (CONTINUED)

SUBJECT	r	N	r/ σ_{r_0}	MEAN		SIGMA	
				MARK	I.Q.	MARK	I.Q.
GRADE XII(CONTINUED)							
Physics	.25	171	3.2	58	117	15	10.4
Chemistry	.17	232	2.5	58	117	16	10.1
Biology	.31	151	3.7	56	120	17	11.1
Aver. Math.- Science	.24	234	3.6	56	117	14	10.2
General Average	.42	319	7.5	56	115	12	10.6
.	.	.	.	.	.	.	.
VOCATIONAL AND GENERAL COURSES							
Mathematics 1	.29	187	3.9	67	104	14	11.3
Mathematics 2	.06	39	0.4	55	103	16	13.7
General Sci.1	.40	85	3.6	64	102	9	11.5
Typing 1	.20	191	2.7	63	104	16	11.2
Typing 2	.44	81	3.9	60	104	15	11.7
Stenography 1	.20	143	2.3	65	103	18	11.4
2	.59	73	4.1	58	104	20	11.7
Book- keeping 1	.16	106	1.6	61	106	17	10.6
Office Practice	.19	76	1.6	65	105	14	12.0

TABLE III (CONTINUED)

SUBJECT	r	N	r/σ_{r_0}	MEAN		SIGMA		
				MARK I.Q.	MARK I.Q.			
VOCATIONAL AND GENERAL COURSES (CONTINUED)								
Arts and Crafts 1	-.14	48	0.9	67	106	11	10.9	
2	.32	21	1.4	67	106	9	11.5	
Automotive 1	.44	62	3.4	65	105	13	11.7	
2	.05	36	0.3	69	108	13	11.9	
Electricity 1	.27	57	2.0	63	106	13	12.2	
2	.46	27	2.3	66	106	11	14.2	
Fabrics and Dress 1	.26	77	2.2	66	108	16	11.9	
2	.30	25	1.5	67	110	13	10.7	
Homemaking 1	.30	72	2.5	68	103	15	11.3	
2	.43	39	2.6	66	105	10	11.6	
Woodwork 1	.27	90	2.6	68	105	10	12.2	
2	.18	58	1.4	71	106	11	12.0	
Printing 1	-.004	25	0.02	57	100	9	12.7	
Printing 2	...	9		..	...	..		
Metalwork 1	.05	43	0.3	59	105	16	11.5	
Metalwork 2	-.27	19	1.1	66	102	8	11.6	

CHAPTER VI

HIGH SCHOOL SUCCESS

The first question which this study attempts to answer, "How are the I.Q.'s obtained on the Laycock Mental Ability Test in junior high school related to subsequent performance in the senior high school?" can be answered quite directly from a table such as Table III without the necessity of any definitions. But questions concerning the value of the test for predicting high school success and the minimum I.Q. necessary for a specified level of success require that high school success be rather exactly defined.

Such a definition is not easy to formulate. In Alberta high schools it is possible to secure a diploma, signifying graduation from high school, with a grading of C in some courses. Getting a diploma on this basis may constitute high school success of a sort, but using such a standard to define it makes a study of this kind meaningless because C standing is within the grasp of nearly all students. Customarily all but the lowest fifteen per cent of students obtain C standing or better. This is not to say that eighty-five per cent of those who enroll in high school obtain the diploma. The records show otherwise. It is obvious, however, that a definition of success that includes eighty-five per cent of a group embraces

such a large section of it as to make discrimination between that section and the remainder of the group practically unnecessary.

The departmental examinations do not have total scores equalling one hundred. Instead, the total may be any number consistent with the values given the individual items on the examination. The custom is to award H standing to the top 5 per cent, A to the next 20 per cent, B to the middle 35 per cent, C to the next 25 per cent, and D to the lowest 15 per cent of students. The lowest score is given a value of 0 and the highest score a value of 100. The raw scores are then transmuted to this scale, 0 to 100, in such a way as to give the correct percentage in each category and to conform to the definitions of the categories in these terms: H, 80 - 100; A, 65 - 79; B, 50 - 64; C, 40 - 49; D, 0 - 39.

In Grade X and Grade XI the marks are assigned by teachers on the basis of the year's work and any local tests that may have been given in the various subjects. Some schools make considerable effort that the various tests for these grades represent reasonably uniform standards and are marked in a reasonably uniform way. Other schools make little attempt of this kind and, if there are several teachers of one

subject, the tests given and the manner of awarding marks will vary with the teachers' idiosyncrasies. Some schools try to follow the departmental pattern of awarding marks but there is little or no uniformity in this regard.

As one of the functions of the high school is to prepare students for university, it seems logical to take as the definition of high school success the standing required for matriculation into the University of Alberta. Formerly this was at least B standing in seven Grade XII subjects and their prerequisites. This is a modest enough standard as it is achieved by 60 per cent of students writing the Grade XII examinations. The revised matriculation requirements specify achievement of at least B standing in six Grade XII subjects with an average of at least sixty, a rather more selective standard though somewhat less comprehensive.

It seemed wise to reject a single definition of high school success in terms of a specific mark in favor of a differential definition that would relate success to the grades awarded and to university matriculation requirements. Four categories were set up: Honors or H standing, 80 or better; A standing or better, 65 and up; University Entrance requirement, 60 and up; B standing or better, 50 and up. It will be seen from these definitions that the standards

become progressively less discriminating as one moves down and that each lower category includes all above it. With regard to the University Entrance criterion it should be noted that no attempt was made to work out a combined rating of B standing in some subjects with an average of 60; rather a mark of 60 in any subject or on the academic average was interpreted as reaching criterion.

Setting up four criteria of success, of different degrees of severity, seemed to offer a better opportunity to assess the usefulness of the Laycock Test as a predictor than would have been the case if only one criterion were used. The test might prove extremely useful in relation to one criterion and of little or no value in connection with another.

It seemed appropriate to apply these standards also to the vocational and general electives. Presumably those who secure the highest standing in such courses will make better workers in shop or office than those who barely scrape through. If an accurate predictor of success in these courses is available, counselling of students will become more efficient.

However, conditions in industry and business differ from those that prevail in high school class-

rooms. The most successful garage mechanic may not necessarily be the student who made top marks in Automotive 2. Similarly, it is known that many successful high school students become mediocre or even poor students at the university. But we are not here attempting to discover a relationship between test scores and post-high school success. Using these criteria of success may enable us to ascertain a little more clearly the predictive power of the test with respect to high school, but does not in any way imply an attempt to extend the prediction beyond that point. Such a study, if it could be carried out, should provide extremely useful and interesting information.

CHAPTER VII

RELATIONSHIP BETWEEN THE LAYCOCK MENTAL ABILITY TEST
I.Q.'S OBTAINED IN JUNIOR HIGH SCHOOL TO SUBSEQUENT
ACHIEVEMENT IN SENIOR HIGH SCHOOL

Column 3 in Table III gives the values of the critical ratio r/σ_{r_0} . Values of 2 or less would occur by chance 4.5 times or more in 100 and are, therefore, of no significance. A value of 2.58 or larger would occur by chance not more than once in a hundred times, while one of 3 or larger would occur by chance only 27 times or less in 10,000. This gives a convenient criterion for answering the question concerning the degree of relationship between the Laycock Test and high school marks.

The subjects for which the value of the critical ratio is 2 or less, and for which no significant relationship has been established are as follows:

Grade XI Latin	Automotive 2
Grade XII Latin	Electricity 1
General Mathematics 2	Metal Work 1 & 2
Bookkeeping 1	Fabrics & Dress 2
Office Practice	Woodwork 2
Arts and Crafts 1 & 2	Printing 1

The subjects for which the relationship is of doubtful significance, the critical ratio being greater than 2 and not more than 2.6 are:

Grade X Latin	Electricity 2
Grade XI French	Stenography 1
Grade XI Chemistry	Fabrics & Dress 1
Grade XII Chemistry	Woodwork 1
Homemaking 1 & 2	

For one subject, Typing 1, a critical ratio of 2.7 indicates a reasonably significant relationship.

For the following subjects the relationship appears to be definitely significant, as the critical ratio in each case is not less than 3:

(a) ACADEMIC

Grade IX	English, Social Studies, French, Average Language-Humanities, Mathematics, General Science, Average Mathematics-Science, General Average.
Grade X	English, Social Studies, French, Average Language-Humanities, Algebra, Physics, Average Mathematics-Science, General Average.
Grade XI	English, Social Studies, Average Language-Humanities, Geometry, General Average.
Grade XII	English, Social Studies, French, Average Language-Humanities, Algebra, Trigonometry and Analytical Geometry, Physics, Biology, Average Mathematics-Science, General Average.

(b) GENERAL AND VOCATIONAL

General Mathematics 1	Typing 2
General Science 1	Stenography 2
Automotive 1	

The relationships discovered are positive and appear to be highly significant for almost all the academic subjects in all grades. The exceptions are Latin in Grades X, XI, and XII, French in Grade XI, and Chemistry in Grades XI and XII. On the other hand, few of the relationships discovered for the general and vocational subjects appear to be significant. Prediction on the basis of Laycock I.Q.'s appears possible for the academic subjects but not for the others.

Except for one or two of the general and vocational subjects, these results do not substantiate the claims of the teachers in the technical and commercial sections of the high school that success in these subjects is closely related to measured intelligence. Probably studies involving greater numbers of students are required to determine this with any definiteness.

The correlation found for Typing 2 was among the highest in the whole study. Yet is one of the courses in which success would appear to be related more to special factors such as finger dexterity, quickness,

and neatness than to general intelligence.

The automotive courses present a rather contradictory picture. The relationship between marks in Automotive 1 and Laycock I.Q.'s appears to be quite significant; but the significance disappears from the relationship in the second year. The correlation between marks in Automotive 1 and Automotive 2 is .75, but only one student making less than 55 marks in Automotive 1 is found in Automotive 2. It would appear that experience and special aptitudes rather than general ability as measured by the Laycock Test are the important factors in success in the second year of this subject. One must not, of course, forget the likelihood of unreliability in the teachers' ratings.

Table IV, Page 40, shows the r 's for Grade IX considerably above those for the other grades except for French, English, Social Studies, and Average Language-Humanities. In Grade IX, the relatively low correlation for French is possibly accounted for by the fact that this is the only subject on which the marks were not obtained by writing a final departmental examination. The more carefully framed and more objectively marked departmental examinations resemble objective achievement tests rather than teacher-made examinations and are likely to show a higher relationship with I.Q.'s than the latter.

TABLE IV. COMPARISON OF THE CORRELATION CO-EFFICIENTS FOR THE ACADEMIC SUBJECTS, GRADES IX THROUGH XII, FOR WHICH SIGNIFICANT RELATIONSHIPS WERE DISCOVERED.

SUBJECT	GRADE			
	IX	X	XI	XII
English	.60	.45	.31	.66
Social Studies	.50	.37	.29	.51
French	.38	.35	--	.28
Average Language-Humanities	.59	.43	.35	.55
Mathematics	.53	---	--	--
Algebra	--	.33	--	.25
Geometry	--	--	.38	--
Trigonometry and Analytical Geometry	--	--	--	.22
General Science	.49	--	--	--
Physics	--	.33	--	.25
Biology	--	--	--	.31
Average Mathematics-Science	.58	.36	--	.24
General Average	.64	.39	.41	.42

The study by Eysenck (6) previously quoted seems to indicate this. The natural question, then, is why, except for English and Social Studies, the Grade XII relationships are so low. Apparently the relationship between Laycock I.Q.'s and marks are consistent for English and Social Studies as far as Grade IX and Grade XII are concerned. The lower correlations in Grades X and XI for these subjects probably reflect the inadequate sample used and, also, the variability and unreliability of the marks given by the teachers in these grades. The fact that the co-efficients for Grades IX and XII English and Social Studies are so similar seems a valid reason for believing that, if gradings could be similarly standardized in Grades X and XI, the correlations would be consistent for these subjects throughout high school.

The lowered correlations for mathematics and science in Grade XII as compared with Grade IX may be accounted for partly by the lapse of time. Greene (7) states: "All types of correlations usually are lowered by inserting longer intervals between the two appraisals which are being compared." On that basis one would expect to find all correlations for Grade XII lower than the corresponding correlations for Grade IX. The consistency of those for English and Social Studies suggests that other factors should be sought.

It is possible that as one advances into senior mathematics and science these subjects call for more and more highly specialized aptitudes rather than for more general intelligence. The variability of marks in science and mathematics for pupils with the same intelligence ratings is much greater than for English. In the two Grade XII mathematics subjects, the low correlations seem to result from the unexpectedly low achievement of high-I.Q. students rather than from the high achievement by those with low I.Q.'s. In science the reverse seems to be true. If specialized aptitudes are involved, they are apparently not too closely related to general intelligence as measured by the Laycock Test.

Another possible explanation is that the Laycock Mental Ability Test measures abilities which find their normal expression in the various activities associated with English and Social Studies rather than in those involved in mathematics and science. The highly verbal nature of the test, the facts that irrespective of its other features a comparatively large vocabulary is essential to a large score and that reading skill must play a considerable part in success on the test, at least suggest this possibility. In the fields of English and Social Studies, reading skills play a larger role

than in mathematics and science, in which success in the higher grades depends to a very considerable degree upon the mastery and memorization of formulas and their application.

At the Grade IX level, the science is more descriptive than theoretical and experimental and much more related to the activities in English and social studies than are the physics and chemistry of Grade XII. The mathematics, too, is more general and demands less rigid memorizing of formulas. This could account for the higher correlations for these subjects in Grade IX than in Grade XII.

The distribution of marks in certain subjects deserves some comment. Grade IX social studies marks have a bi-modal distribution. Of the 769 students, 113 were found in the class interval 55 - 59 and 107 in the interval 90 - 94. The mean mark in this subject was 66. The bi-modality disappeared when the average language-humanities mark was computed. The same type of distribution appeared in Grade IX science with 113 in the interval 55 - 59 and 111 in the interval 90 - 94. Apparently two quite different types of skill or performance were being measured in these subjects. The Grade X Latin marks showed an almost rectangular distribution, which was shared, though not quite to

the same degree, by the Grade X French marks. A similar type of rectangularity with no appreciable piling up about the mean was found in the marks for Grade X algebra, Grade XI French, and Grade XI chemistry.

Earlier it was suggested that the correlations for the group in Grade IX who subsequently wrote certain examinations in Grade XII might be useful in this study. These are presented in Table V.

TABLE V. CORRELATIONS FOR GRADE IX STUDENTS SUBSEQUENTLY WRITING GRADE XII EXAMINATIONS IN THE SUBJECTS SHOWN COMPARED WITH CORRELATIONS IN GRADE XII AND CORRELATIONS FOR THE WHOLE GRADE IX GROUP.

SUBJECT	WHOLE GRADE IX GROUP	GRADE IX GROUP LATER IN GRADE XII	GRADE XII GROUP
English	.60	.58	.66
French	.38	.20	.28
General Mathematics	.53	.38	
Algebra			.25
Trigonometry and Analytical Geometry			.22
General Science	.49	.25	
		Physics	.25
		Chemistry	.17
		Biology	.31

Table V cannot be considered without reference

TABLE VI. NUMBER (N) IN GRADES IX AND XII FOR ENGLISH, FRENCH, MATHEMATICS, AND GENERAL AVERAGE WITH THE DIFFERENCE (D) STATED AS A PER CENT OF N_9 .

I.Q.	ENGLISH			FRENCH			MATHEMATICS			AVERAGE		
	N_9	N_{12}	%	N_9	N_{12}	%	N_9	N_{12}	%	N_9	N_{12}	%
145-149	3	2	33	2	0	100	3	1 ⁽¹⁾	67	3	1	67
140-144	2	2	0	1	0	100	2	2	0	2	2	0
135-139	13	10	23	13	7	46	13	7	46	13	10	23
130-134	15	11	27	14	8	43	15	9	40	15	10	33
125-129	51	46	10	45	23	49	51	33	34	51	40	22
120-124	93	61	33	74	30	59	93	40	57	93	52	44
115-119	98	64	35	79	31	61	98	39	60	98	57	42
110-114	114	60	47	90	14	84	114	29	75	114	51	55
105-109	142	75	47	109	21	81	142	30	79	142	52	63
100-104	90	34	62	66	13	80	90	14	84	90	23	74
95- 99	69	24	65	54	5	91	69	4	94	69	12	83
90 - 94	37	8	78	27	2	93	37	3	92	37	6	84
85 - 89	28	8	71	21	1	95	28	1	96	28	3	89
80 - 84	11	3	73	8	0	100	11	0	100	11	0	100
75 - 79	3	0	100	2	0	100	3	0	100	3	0	100
Totals	769	408	47	605	155	74	769	212	72	769	319	59
120-149	177	132	25	149	68	56	177	92	48	177	115	35
100-119	444	233	48	344	79	77	444	112	75	444	183	59
75- 99	148	43	72	112	8	93	148	8	95	148	21	86

(1) The Grade XII mathematics subjects are combined, the lower number in each instance being taken.

to Table VI which indicates the considerable difference in the constitution of the two groups. The group writing Grade XII English comprised the entire high school population at that grade level but that writing the other subjects only a portion of it, that is, the academic section, and the group writing French only a portion of that section. It is interesting to note that when these groups are selected out of the total Grade IX population under consideration, the correlations drop to values substantially similar to those for Grade XII. This clearly indicates that the lowered correlations for Grades X, XI, and XII result from selection processes as well as from other factors, some of which have already been referred to.

Table VI shows that almost three quarters of the group with I.Q.'s below 100 drop out of high school before the completion of Grade XII and only one quarter of those with I.Q.'s of 120 and up. However, for the academic subjects the proportions appear to be about 95 per cent and 50 per cent respectively. The lowered correlations for Grade XII appear to indicate that the performance of this more able group remaining is affected by many factors other than intelligence. The study by Ames (13) previously referred to shows school success to be related to social success and adjustment to school pattern as well as persistence

and attitude to school. It is a common observation that many high school students tend to dissipate their energies upon many activities with consequent loss of marks. Others, who are possessed of a strong drive to succeed, overcome what appear to be considerable intellectual limitations.

In connection with Table VI, it should be noted that the differences shown are those between the numbers of students entering Grade X who wrote certain examinations in Grade IX and the numbers writing examinations in those subjects in Grade XII. It does not show the numbers who enrolled in a particular program and subsequently dropped it. Therefore, the Table is a rather crude indicator at best.

From the data so far examined here, the fact emerges that the correlation of Laycock I.Q.'s with marks in English is stable and consistently higher than those for other subjects. From this, it seems safe to conclude that a much closer relationship exists between the test and this subject than exists in other areas.

Significant positive relationships between Laycock I.Q.'s and high school achievement were discovered for most of the academic subjects. None of the relationships are as high as those shown in the

test manual. They lie, however, towards the middle of the range which is suggested by the various studies reported in the literature. Therefore, in relation to the criterion of school marks, the Laycock Test can be accepted as reasonably valid. The general lack of significance in the relationship between I.Q.'s and marks in the vocational and general subjects may come from the fact that success in these subjects results from "other qualities that are really important." If these other qualities are in fact components of intelligence, the inference would be that the test has many shortcomings as a measure of intelligence, its higher relationship with the academic subjects being caused by the verbal characteristics it shares with them. On the other hand, the generally lower relationships found in connection with the technical and commercial subjects may simply reflect the fact that the teachers of these subjects award marks for effort and attitude, rather than for actual accomplishment as measured by some suitable standard of achievement. This problem is worthy of more thorough investigation.

CHAPTER VIII

THE PREDICTION OF HIGH SCHOOL SUCCESS

Tables VII to X show the percentages in three I.Q. ranges, 120 - 149, 100 - 119, and 75 - 99, meeting the four criteria of success previously defined in these terms: Honors or H standing, 80 and up; A standing or better, 65 and up; University Entrance, 60 and up; B standing or better, 50 and up. These criteria are applied first to the academic subjects. A later section will deal with their application to the vocational and general subjects. In these tables Group I, represents those in the I.Q. group 120 - 149, Group II, I.Q. range 100 - 119, Group III, I.Q. range 75 - 99. Table II shows that these groups are roughly comparable to the top 25 per cent, the middle 50 per cent, and the bottom 25 per cent, respectively, of the Grade IX group. But they constitute respectively the top 32 per cent, the middle 57 per cent, and the bottom 11 per cent of the group writing Grade XII English, that is, the entire Grade XII group or, to be more precise, the entire section of this group left in Grade XII to write this examination. Grades X and XI are not included in these tables because high school success requires the completion of Grade XII.

TABLE VII. PERCENTAGES OF GROUPS I, II, III, and WHOLE GROUP ACHIEVING HONORS OR H STANDING ON THE ACADEMIC SUBJECTS OF GRADES IX AND XII FOR WHICH SIGNIFICANT RELATIONSHIPS WERE DISCOVERED.

SUBJECTS	GROUPS			WHOLE
	I	II	III ⁽¹⁾	
GRADE IX				
English	41	13	3	17
Social Studies	56	27	5	30
French	40	20	9	23
Average Language- Humanities	37	10	2	15
Mathematics	39	14	1	17
Science	56	27	6	30
Average Math.-Science	41	12	1	17
General Average	33	8	1	13
.....				
GRADE XII				
English	18	4	0	8
Social Studies	14	7	0	8
French	7	3	0	5
Average Lang.-humanities	8	1	0	4
Algebra	8	4	0	6
Trigonometry and Analytical Geometry	9	4	0	6
Physics	14	6	0	9
Biology	20	10	7	13
Average Math.-Science	8	3	0	5
General Average	7	2	0	4

(1) I.Q.'s: I, 120 - 149; II, 100 - 119; III, 75 - 99

TABLE VIII. PERCENTAGES OF GROUPS I, II, and III, AND WHOLE GROUP ACHIEVING A STANDING OR BETTER ON THE ACADEMIC SUBJECTS OF GRADES IX AND XII FOR WHICH SIGNIFICANT RELATIONSHIPS WERE DISCOVERED.

SUBJECTS	GROUPS ⁽¹⁾			
	I	II	III	WHOLE

GRADE IX				
English	75	35	9	39
Social Studies	77	48	20	48
French	77	55	33	56
Average Lang.-Humanities	80	43	13	46
Mathematics	58	24	4	28
Science	75	44	18	45
Average Math.-Science	69	35	7	38
General Average	76	38	4	40
.				
GRADE XII				
English	67	27	5	38
Social Studies	55	33	7	37
French	29	16	0	21
Average Lang.-Humanities	49	22	2	29
Algebra	29	13	0	19
Trigonometry and Analytical Geometry	37	21	13	28
Physics	48	31	14	37
Biology	43	31	13	33
Average Math.-Science	39	24	13	30
General Average	37	20	5	25

(1) I.Q.'s: I, 120 - 149; II, 100 - 119; III, 75 - 99

TABLE IX. PERCENTAGES OF GROUPS I, II, III, AND WHOLE GROUP MEETING UNIVERSITY ENTRANCE CRITERION IN THE ACADEMIC SUBJECTS OF GRADES IX AND XII FOR WHICH SIGNIFICANT RELATIONSHIPS WERE DISCOVERED.

SUBJECTS	GROUPS ⁽¹⁾			
	I	II	III	WHOLE
GRADE IX				
English	84	46	12	48
Social Studies	81	52	24	53
French	83	65	46	65
Average Lang-Humanities	90	59	24	59
Mathematics	66	28	5	32
Science	77	48	19	49
Average Math-Science	80	45	14	46
General Average	86	51	14	52
.....				
GRADE XII				
English	83	41	12	51
Social Studies	68	48	11	50
French	51	30	0	38
Average Lang-Humanities	74	43	12	50
Algebra	39	25	11	30
Trigonometry and Analytical Geometry	46	34	25	39
Physics	55	41	14	46
Biology	50	36	13	38
Average Math-Science	50	38	13	42
General Average	53	32	10	38

(1) I.Q.'s: I, 120 - 149; II, 100 - 119; III, 75 - 99.

TABLE X. PERCENTAGES OF GROUPS I, II, III, AND WHOLE GROUP ACHIEVING B STANDING OR BETTER ON THE ACADEMIC SUBJECTS IN GRADES IX AND XII FOR WHICH SIGNIFICANT RELATIONSHIPS WERE DISCOVERED.

SUBJECTS	GROUPS			WHOLE
	I	II	III ¹	
GRADE IX				
English	95	70	35	69
Social Studies	94	84	54	81
French	97	87	79	88
Average Lang-Humanities	98	84	53	81
Mathematics	84	59	24	57
Science	95	75	49	75
Average Math-Science	93	52	34	58
General Average	97	81	41	77
.....				
GRADE XII				
English	96	75	28	77
Social Studies	92	73	41	76
French	79	60	13	66
Average Lang-Humanities	94	74	27	76
Algebra	66	48	44	55
Trigonometry and Analytical Geometry	71	62	63	66
Physics	77	69	29	71
Biology	76	50	27	56
Average Math-Science	74	63	38	67
General Average	87	66	24	71

1. I.Q.'s: I, 120 - 149; II, 100 - 119; III 75 - 99.

TABLE XI. NUMBERS IN GROUPS I, II, and III, AND WHOLE GROUP FOR THE VARIOUS SUBJECTS TREATED IN TABLES VII TO X.

SUBJECTS	GROUPS			
	I	II	III	WHOLE
GRADE IX				
English ⁽¹⁾	177	444	148	769
Science ⁽²⁾	177	443	148	768
French	149	344	112	605
GRADE XII				
English	131	233	43	407
Social Studies	132	230	44	406
French	68	79	8	155
Average Lang-Humanities	130	224	41	395
Algebra	100	134	9	243
Trigonometry and Analytical Geometry	93	112	8	213
Physics	71	93	7	171
Biology	46	90	15	232
Average Math-Science	101	125	8	234
General Average	115	183	21	319

(1) Also social studies, average language-humanities, mathematics, and general average.

(2) Also average mathematics-science.

There is little point in considering a partially completed course in relation to success.

Tables VII to X must be viewed in the light of the information presented by Table XI concerning the numbers in each group, especially the very small number in Group III for the Grade XII subjects. For the most part, there are sufficient cases in the two other groups to warrant drawing conclusions about the probability of success but for Group III any conclusions drawn must be highly tentative. Although stating the percentage in each group achieving a certain level of success, as is done in Tables VII to X, obscures the numbers involved and gives the groups a kind of spurious equality, it has a definite use in prediction as it shows at least the approximate proportion of each group likely to succeed in meeting each criterion.

The data represented in these tables indicated that members of Group III have no chance at all of completing the high school academic program with H standing. It must be kept in mind, however, that if larger numbers of this particular group were studied somewhat different conclusions might be reached. Though the performance of this small group may not be typical, it is sufficiently close to what one would expect

of students with this kind of measured intelligence to merit at least provisional acceptance.

It is obvious that these three groups can be quite sharply distinguished by the percentage of each securing success. It is also to be noted that the distinctions are clearest when the most severe criterion is used and that they become less and less marked as the criterion becomes less demanding. As differences in intelligence should be more evident in relation^{to} differences in performance at a high level than at a low level, this fact is further evidence of the validity of the Laycock Test.

All groups appear to have more difficulty achieving the same degree of success in mathematics as in other subjects at both the Grade IX and Grade XII levels. Apparently, also, they find the Grade XII algebra more difficult than the combined trigonometry and analytical geometry course. The Grade XII students found it impossible to obtain the same level of success in French as in English, although Groups II and III found Grade IX French among their easy subjects. (One assumes that in this grade many marks were given for effort rather than for actual linguistic attainment.) However, the variability in the performance of each group at the Grade XII level, except for Group III

in relation to the highest criterion, suggests that requirements for success in these subjects are by no means uniform. One would expect that, if the instruction is efficient, the subjects at any grade level should make substantially similar demands upon the abilities of students. It may be that requirements in some subjects are too low, in others too high, or that the amount of instruction is not properly related to the standard required, or that instruction in some subjects is more efficient than in others. It may be, too, that the final examinations in some subjects are more closely related to the work of these courses than is the case for others. It may also be true that these subjects make demands upon different specific aptitudes which do not correlate highly either with general intelligence or with each other. Any of these problems would be interesting as a field for further investigation.

If it can be assumed that Grade XII courses make substantially similar demands upon abilities of students at that level to those which the Grade IX courses make upon the abilities of Grade IX students -- and, if courses are properly placed and graded, this seems a reasonable assumption -- the generally lower performance of all groups in Grade XII as compared with

Grade IX indicates the existence of factors operating in the senior high school which are absent in the junior high school or, at least, which do not operate to the same extent. One would expect a weeding out of students with lower ability and a gradual dropping off in their performance as they attempt the senior courses, but one would expect, also, that more of the students of high ability would perform well.

Of particular concern is the performance of Group I, students with I.Q.'s above 120, in relation to the lowest criterion of success. While Table X shows a bigger proportion of this group than of either of the others securing B standing, a substantial section of it fails to attain even this modest success on the Grade XII examinations, especially in mathematics and science.

In so far as we are safe in generalizing from these data, we can make certain predictions of success. Because of the differences in the numbers involved, these predictions are probably more valid for Grade IX than for Grade XII; but even for Grade XII they will have considerable validity for groups though very little for individuals, especially for those in Group III.

TABLE XII PROPORTION OF GROUPS I, II, AND III
ACHIEVING VARIOUS LEVELS OF SUCCESS ON THE GENERAL
AVERAGE OF THE GRADE IX AND GRADE XII EXAMINATIONS.

GRADE IX GENERAL AVERAGE						
GROUPS						
	I		II		III	
	N...177		N...444		N...148	
	No.	%	No.	%	No.	%
H Standing (80 or better)	59	33	37	8	1	1
A Standing (65 or better)	135	76	168	38	6	4
University Entr. (60 or better)	152	86	227	51	21	14
B Standing (50 or better)	171	97	359	81	61	41

GRADE XII GENERAL AVERAGE						
GROUPS						
	I		II		III	
	N...115		N...183		N...21	
	No.	%	No.	%	No.	%
H Standing	8	7	4	2	0	0
A Standing	43	37	36	20	1	5
University Entr.	61	53	58	32	2	10
B Standing	100	87	122	66	5	24

Table XII reduces the information given in Tables VII to X to a statement of the proportion of each group meeting each criterion of success on the general average at each of the Grade IX and Grade XII levels. The percentage figure indicates the possibilities in one hundred of a member of the group concerned achieving that specific level of success. The actual numbers involved are also given to prevent drawing unwarranted conclusions from the percentages when the size of the group is especially small.

Tables VII to X show that the percentage of each group achieving a particular level of success on the general average of either Grade IX or Grade XII is generally lower than that meeting the same criterion on individual examinations. Prediction in terms of the average is satisfactory for most purposes, because success in high school demands the completion of a total program, not merely isolated portions of it. Consequently Table XII seems to offer the data needed for satisfactory practical predictions of this sort.

Table XII emphasizes what is obvious from the relationships shown in Table III, namely, that it is easier to make predictions of success for Grade IX than for Grade XII. The first section of the table shows the probability of success on the Grade IX

examinations. Apparently a member of Group I has 33 chances in 100 of achieving Honors standing while a member of Group III has not more than 1 chance in 100 of doing work of similar standard. It must be repeated, however, that too much generalizing from these data is not desirable. This group does not represent the whole Grade IX population, even for Calgary, but only that portion of it which entered high school. Nevertheless, a rather large group is involved; so some tentative conclusions and generalizations may be drawn. It would be necessary, of course, to have data respecting larger numbers of Grade IX students to be able to say with any definiteness to a member of Group II in Grade VII or VIII, "You have 38 chances in 100 of getting at least A standing on the Grade IX examinations. The chances are about two to one against you." Cautious predictions of this nature are justified, however, by the significant relationships indicated in Table III for this grade.

Data for 997 Calgary Grade IX students in 1948, classified in a slightly different way, are available which tend to substantiate Table XII. This information is given in Table XIII for the three criteria, H, A, and B standings, for I.Q. groupings slightly different from those used in this study.

TABLE XIII. PERCENTAGES OF CALGARY GRADE IX STUDENTS ACHIEVING H STANDING, A STANDING, AND B STANDING ON THE 1948 DEPARTMENTAL EXAMINATIONS.

I.Q. GROUP	PERCENTAGE OF EACH GROUP ACHIEVING		
	H STANDING	A STANDING	B STANDING
121 - 150	37	91	99
101 - 120	6	54	89
65 - 100	0.3	11	51
Whole Group	10	47	79

The percentages in Table XIII are very similar to those in Table XII. The difference in the I.Q. groupings would tend to increase the percentage in each group succeeding at a certain level as it would include the lower section of what we have called Group I with the middle group and the lower section of Group II with Group III. As the average achievement of each group has been above that of the next lower group, this would have the effect of raising the percentage in each meeting the designated criterion of success. Table XIII can therefore be accepted as at least a qualified corroboration of the argument we have just developed regarding the prediction of success in Grade IX.

When it comes to predicting success at the Grade XII level, a reference to Table XII will not suffice.

This table shows the percentages of the various groups writing the Grade XII examinations that achieved specified levels of success. It does not show the number of students who dropped out of school or who enrolled in the academic program. Further, the way the general average for this grade was computed permits some students to be recorded here who actually did not complete the full academic program. Consequently the data in the second section of Table XII must be interpreted with great caution.

One may not say, for example, that 7 out of 100 students in Group I will achieve honors standing on the general academic average of Grade XII, but only that about 7 in 100 of those writing the examinations are likely to do so. To obtain some predictive basis, the information in Table XII must be combined with that in Table VI, which shows the percentage drop in enrollment from Grade IX to Grade XII for the students included in this survey. According to this table, 65 % of Group I, 41 % of Group II, and 14 % of Group III who wrote on the Grade IX examination are included in the academic average for Grade XII. If any prediction of success at the Grade XII level is attempted early in high school, this fact must be considered. The percentages indicated in the second

section of Table XII must be multiplied by .65, .41, and .14 for Groups I, II, and III, respectively, to show the percentages of students beginning Grade X likely to meet any specific criterion of success in Grade XII. For predictions at other stages in high school similar corrections for drop-outs must be made. Combining this information gives Table XIV.

TABLE XIV. PERCENTAGES OF GROUPS I, II, AND III COMMENCING HIGH SCHOOL LIKELY TO ACHIEVE THE LEVELS OF SUCCESS INDICATED ON THE GRADE XII ACADEMIC AVERAGE.

CRITERIA	GROUP I	GROUP II	GROUP III
H Standing	5	0.8	0
A Standing	24	8	0.7
University Entrance	34	13	1.5
B Standing	57	27	3.5

When the rate of dropping out of high school before the completion of Grade XII and the fact that a considerable number of those entering high school enroll in other than the academic program are considered, the probability of success in it is cut sharply. The

group with the highest proportion of drop-outs suffers most. It is evident from Table VI that only a small porportion of Group III completes the academic program. This fact coupled with the low success rate of this group means that only 3 or 4 out of 100 who start the high school program achieve even such a moderate success as B standing and less than half that number reach the standard required for university entrance. Less than 1 in 100 secures A standing and none at all achieves honors rating.

Strictly speaking, the figures in Table XIII and Table XIV may fail to present an entirely accurate picture, because they imply that all the students represented in the Grade IX general average actually enrolled in the academic high school program. Such is not the case. The original group was divided among four types of programs, so that for the group actually entering the academic program the drop-out rate shown is probably high. Therefore, the probability of success shown for each group in Table XIV is somewhat lower than it should be. However, this table does provide a useful estimate of success in this program.

Provincial enrollment figures for Grades IX and XII supplied by the Department of Education are presented in Table XV for comparison with Table VI.

TABLE XV. PROVINCIAL ENROLLMENT IN GRADE IX FOR THE FIVE-YEAR PERIOD COMMENCING 1945 AND IN GRADE XII FOR THE FIVE-YEAR PERIOD COMMENCING 1948.

YEAR	GRADE IX	YEAR	GRADE XII	DIPLOMAS GRANTED
1945	11376	1948	6302	2710
1946	11352	1949	6179	2753
1947	11299	1950	6258	2852
1948	10768	1951	6239	2819
1949	11062	1952	6158	(Not given)

The decrease in the general enrollment approximates 45 per cent from Grade IX to Grade XII. This is close to the 47 per cent shown in the first section of Table VI for English. The drop from the Grade IX enrollment to the number of diplomas issued three years later approximates closely the drop for French and Mathematics also shown in Table VI.

The various tables in this section give good ground for predicting high school success, especially for groups, on the basis of the Laycock Mental Ability Test. If academic success in high school is a valid

criterion of intelligence --and it has long been accepted as such -- the differences in the percentages of Groups I, II, and III obtaining success furnishes strong evidence in favor of the validity of the Laycock Test.

CHAPTER IX
THE PREDICTION OF SUCCESS
IN GENERAL AND VOCATIONAL SUBJECTS

Up to this point we have been considering the prediction of success in the academic program. We shall now examine the possibility of predicting success in the general and vocational courses from I.Q.'s obtained on the Laycock Test.

Table III reveals that the relationships between Laycock I.Q.'s and marks in almost all of these subjects are of little or no significance. Consequently, it appears that prediction with any degree of accuracy is impossible. However, for six subjects in this section significant relationships were obtained. There is insufficient evidence to determine whether this departure from the general pattern is typical of these six subjects or whether it is the result of chance factors. Only a study of a number of classes over several years can answer this question.

Some values may be derived from a breakdown of these courses similar to that made in Tables VII to X for the academic subjects. All of the courses in these sections are included but only three criteria of success are considered. The University Entrance criterion is omitted because none of these courses is admissible for entrance to the University of Alberta except as an elective to which the sixty per cent

rule does not apply.

A study of Table XVI shows that even for the subjects for which the relationship between marks and I.Q.'s appears to be significant the percentage attaining any level of success does not become consistently lower as we move from Group I to Group III. The performance of adjacent groups is frequently reversed. Table XVI indicates that there is little relationship between success in these courses and Laycock I.Q.'s except possibly for the Honors criterion. Consequently, prediction of success in these courses cannot be made from these I.Q.'s. Having in mind that the generally low relationships are accompanied usually by quite small numbers, one can only say that more data are necessary to dispose of this question. Certainly this study provides no basis for prediction in this area. Whether or not more comprehensive studies would do so is another question.

On the face of it, one would expect that success in these general and vocational subjects would be more closely related to such things as specific aptitudes, and qualities like application, perseverance, neatness, co-operativeness, agreeableness of manners, pleasant personalities, and effort than to general intelligence,

TABLE XVI. PERCENTAGES OF STUDENTS IN GROUPS I, II, AND III OBTAINING SPECIFIC LEVELS OF SUCCESS IN THE GENERAL AND VOCATIONAL COURSES IN GRADES X AND XI.

SUBJECTS	HONORS STANDING			A STANDING			B STANDING		
	I	II	III	I	II	III	I	II	III
General Mathematics									
1	29	19	3	65	60	36	88	94	86
2	20	0	0	20	43	15	40	81	69
General Science 1	25	4	3	50	51	19	100	98	97
Typing 1	41	17	7	59	48	33	94	87	83
2	33	11	11	67	39	14	100	77	75
Stenography 1	31	26	17	85	43	32	100	79	83
2	33	22	4	78	39	9	100	78	35
Bookkeeping	33	10	8	67	31	23	83	88	85
Office Practice	44	17	0	67	40	32	89	93	100
Arts and Crafts 1	0	13	18	43	63	73	100	97	91
2	25	9	17	75	55	50	100	100	100
Automotive 1	13	21	0	75	68	25	100	94	70
2	14	25	0	57	85	44	86	95	67
Electricity 1	29	14	7	86	44	36	100	89	50
2	25	13	0	100	69	14	100	88	100
Fabrics & Dress 1	25	16	11	69	58	50	88	81	72
2	50	0	20	83	57	40	100	79	100

TABLE XVI (CONTINUED)

SUBJECTS	HONORS			- A -			- B -		
	I	II	III	I	II	III	I	II	III
Homemaking 1	14	19	4	71	54	29	100	81	86
2	40	5	0	60	59	8	100	100	100
Woodwork 1	20	13	0	70	75	44	100	96	89
2	25	28	0	75	69	71	89	97	93
Printing 1	0	0	0	0	18	23	100	64	69
Metalwork 1	33	8	14	67	27	43	100	61	78
2	0	6	0	0	55	86	100	100	100

especially of the verbal type. Something like this seems to be the case in relation to the two lower criteria of success. There is a possibility that general intelligence is more closely related to the achievement of a high level of success in these subjects, but the present data do not permit the drawing of that conclusion. The consistent differences shown for Stenography 2, which has an r of .59 evidently indicate a closer relationship between general intelligence and achievement in this subject than that which prevails for any other in the section.

CHAPTER X

THE MINIMUM I.Q. NECESSARY FOR SUCCESS

The question concerning the minimum I.Q. essential to high school success will be considered only in connection with the academic subjects. From the standpoint of effective counselling this is an important problem. As Super (19) says, "Not only the trends, as indicated by averages, are necessary, but even more needed are minimum critical scores which show what score a student should make to be a good risk in each type of training."

The question has already been partly answered. Table VII shows that no student with an I.Q. lower than 100 achieved honors standing in Grade XII. However, more detailed analysis is required. The next four tables, XVII, XVIII, XIX, and XX, will deal respectively with the percentages achieving honors standing, A standing, University Entrance standing, and B standing on the examination subjects in Grades IX and XII for which significant relationships were discovered between marks and Laycock I.Q.'s. The Grade IX French has been omitted. As these tables attempt a detailed analysis according to class intervals of 5 I.Q. points, the numbers in the groups at each end of the range are very small. The results

TABLE XVII. PERCENTAGES OF STUDENTS ACHIEVING HONORS STANDING ON GRADE IX AND GRADE XII EXAMINATION SUBJECTS FOR WHICH SIGNIFICANT RELATIONSHIPS WERE DISCOVERED.

SUBJECTS	I.Q. MID-POINTS														
	77	82	87	92	97	102	107	112	117	122	127	132	137	142	147
GRADE IX															
English	0	0	7	0	3	6	9	9	29	34	39	53	77	100	33
Social															
Studies	0	9	0	11	4	14	19	32	43	45	63	67	77	100	100
Average															
Lang-Human.	0	0	0	0	4	4	7	11	30	27	39	40	77	100	67
Mathematics	0	0	0	0	1	6	9	17	26	34	43	47	46	50	67
Science	33	0	4	8	6	17	21	29	44	51	59	80	54	100	67
Average															
Math-Sci.	0	0	0	0	1	2	7	15	23	29	53	60	38	100	67
General															
Average	0	0	0	0	1	1	7	5	20	26	39	40	46	100	33
Grade XII															
English	--	0	0	0	0	0	0	2	13	16	15	18	20	100	50
Social St.	--	0	0	0	0	3	1	3	17	8	20	27	20	0	0
French	--	-	0	0	0	8	0	0	3	10	9	0	0	---	--
Average															
Lang-Human	--	0	0	0	0	0	0	0	5	3	16	9	10	0	0
Algebra	--	-	0	0	0	6	3	3	6	7	8	0	29	0	0
Trigonometry															
& An. Geom.	--	-	0	0	0	0	3	7	5	8	9	11	13	0	0
Physics	--	-	-	0	0	14	10	0	6	12	14	20	17	--	0
Biology	--	-	0	0	10	0	10	4	22	8	25	100	17	50	--
Average															
Math-Sci.	--	-	0	0	0	0	3	3	4	7	11	0	12	0	0
General															
Average	--	-	0	0	0	0	2	0	5	6	10	0	10	0	0

Note: The dashes used here and in the next three tables indicate that the particular I.Q. group was not represented.

TABLE XVIII. PERCENTAGES OF STUDENTS ACHIEVING A STANDING OR BETTER ON EXAMINATION SUBJECTS GRADES IX AND XII FOR WHICH SIGNIFICANT RELATIONSHIPS WERE DISCOVERED.

I.Q. MID - POINTS

SUBJECTS	77	82	87	92	97	102	107	112	117	122	127	132	137	142	147
GRADE IX															
English	0	0	7	3	14	20	31	37	53	66	78	93	92	100	100
Social Studies	0	18	14	27	19	31	41	46	65	73	76	80	92	100	100
Average															
Lang-Human	0	0	7	11	19	23	34	49	66	74	80	93	92	100	100
Mathematics	0	0	0	5	6	11	19	30	37	48	61	73	77	100	100
Science	33	0	14	24	17	26	39	51	61	71	75	93	85	100	67
Average															
Math-Sci.	33	0	4	11	7	17	29	43	52	62	69	87	92	100	100
General															
Average	0	0	0	5	6	14	32	42	63	71	78	100	92	100	100
GRADE XII															
English	--	0	0	13	4	9	19	23	50	57	76	64	80	100	50
Social St.	--	0	0	14	8	25	24	33	48	48	64	45	50	100	50
French	--	--	0	0	0	30	10	21	13	30	30	38	14	--	--
Average															
Lang-Hum---	0	0	14	0	16	17	19	35	40	58	55	50	100	50	
Algebra	--	--	0	0	0	6	6	14	21	27	27	44	29	50	0
Trigonometry															
& An. Geom--	--	--	0	33	0	7	17	28	26	25	42	56	50	0	100
Physics	--	--	--	0	33	14	30	35	36	42	54	40	67	--	0
Biology	--	--	0	0	20	25	20	36	43	42	42	100	33	50	--
Average															
Math-Sci.	--	--	0	0	25	12	22	32	24	32	42	50	50	50	0
General															
Average	--	--	0	0	8	13	15	22	25	25	45	50	50	50	100

TABLE XIX PERCENTAGES OF STUDENTS ACHIEVING 60 OR BETTER ON
EXAMINATION SUBJECTS GRADES IX AND XII FOR WHICH SIGNIFICANT
RELATIONSHIPS WERE DISCOVERED.

SUBJECTS	I.Q. MID - POINTS														
	77	82	87	92	97	102	107	112	117	122	127	132	137	142	147
GRADE IX															
English	0	0	7	5	20	27	43	46	67	80	82	100	92	100	100
Social															
Studies	0	18	21	30	23	36	47	54	71	76	84	87	92	100	100
Average															
Lang-Hum.	0	9	11	22	35	41	51	65	81	85	92	100	100	100	100
Mathematics	0	0	0	5	9	17	22	34	40	55	71	80	92	100	100
Science	33	0	14	27	19	28	44	56	62	74	77	93	85	100	67
Average															
Math-Sci.	33	0	11	16	16	27	39	54	59	75	76	100	100	100	100
General															
Average	0	0	7	14	20	29	44	57	74	82	88	100	100	100	100
GRADE XII															
English	--	10	13	13	13	21	31	35	67	77	85	82	100	100	100
Social St.	--	0	0	14	16	38	38	44	68	61	73	73	70	100	100
French	--	--	0	0	10	38	24	36	29	47	52	63	57	--	--
Average															
Lang-Hum.	--	0	0	14	17	28	27	49	62	65	80	73	90	100	100
Algebra	--	--	0	0	20	12	17	34	30	32	43	56	43	50	0
Trigonometry															
& An. Geom.	--	--	0	33	25	14	37	38	36	38	55	56	50	0	100
Physics	--	--	--	0	33	29	45	39	44	50	61	50	67	--	6
Biology	--	--	0	0	20	33	23	36	52	54	42	100	33	50	--
Average															
Math-Sci.	--	--	0	0	25	24	31	45	44	36	61	60	50	50	100
General															
Average	--	--	0	17	8	22	21	35	42	44	60	70	50	50	100

TABLE XX. PERCENTAGES OF STUDENTS ACHIEVING B STANDING OR BETTER ON EXAMINATION SUBJECTS GRADES IX AND XII FOR WHICH SIGNIFICANT RELATIONSHIPS WERE DISCOVERED.

I. Q. MID - POINTS															
SUBJECTS	77	82	87	92	97	102	107	112	117	122	127	132	137	142	147
GRADE IX															
English	0	9	32	22	49	56	64	75	86	96	90	100	100	100	100
Social															
Studies	67	27	54	65	52	72	78	91	96	92	96	93	100	100	100
Average															
Lang-Hum.	33	36	43	54	61	73	78	89	95	97	100	100	100	100	100
Mathematics	33	0	14	22	33	51	55	63	68	78	86	93	100	100	100
Science	66	22	54	57	48	56	72	84	87	92	98	100	100	100	100
Average															
Math-Sci.	33	0	25	38	41	54	63	81	84	89	94	100	100	100	100
General															
Average	33	9	29	43	51	73	73	89	89	95	100	100	100	100	100
GRADE XII															
English	--	0	13	13	42	65	60	80	92	92	98	100	100	100	100
Social St.	--	33	22	43	48	63	65	71	87	89	96	100	90	100	100
French	--	--	0	0	20	46	62	71	58	73	83	88	86	--	--
Average															
Lang-Hum.	--	0	13	14	39	53	63	78	94	93	93	100	90	100	100
Algebra	--	--	100	67	20	41	37	49	57	55	76	89	57	50	100
Trigonometry															
& An. Geometry	--	100	67	50	54	63	59	64	65	79	78	63	50	100	
Physics	--	--	--	0	67	64	75	74	64	69	79	90	83	--	100
Biology	--	--	33	0	30	42	47	44	65	71	83	100	67	100	--
Average															
Math- Sci.	----	100	33	25	59	56	65	69	70	75	90	75	50	100	
General Average															
	--	--	33	33	17	57	60	57	86	81	95	90	80	100	100

would be more meaningful if a study involving several classes were made so that three or four times the number in each interval could be dealt with. Within these limitations, however, these tables provide valuable information on this question. They show a lack of consistency in the performance from subject to subject of each I.Q. group. Because of the difficulty of establishing a minimum I.Q. applicable to all subjects separately, the use of the general average for this purpose seems justified.

Table XVII shows that a Laycock I.Q. of at least 95 is necessary to secure H standing on the Grade IX general average. As only 1 % of the I.Q. groups 95 - 99 and 100 - 104 reach this standing, the practical minimum seems to be 105, which also appears to be the absolute minimum for securing the same standing on the Grade XII general average. The practical minimum for Grade XII appears to be 115.

Table XVIII shows that to meet the A standing criterion of success the minimum I.Q. for Grade IX is 90 and for Grade XII is 95. The two lowest groups find this level of achievement impossible in Grade IX and drop out, for the most part, before completing

high school. While this level of achievement is apparently as far out of the reach of the lowest groups as is the honors standing, the upper groups show consistently higher percentages achieving at this level as compared with the higher criterion.

Table XIX shows that achieving a standing equivalent to university entrance requirements seems equally beyond the attainment of the two lowest groups in Grade IX and the three lowest in Grade XII. The minimum I.Q.'s for success at this level are 85 and 90 for Grades IX and XII respectively. The slight changes in the percentages of the groups achieving success as compared with those meeting the A standing criterion, increasing somewhat from Table XVIII to Table XIX, reflect the slight decrease in the severity of the standard from 65 to 60.

The data presented in Table XX indicated that the Minimum I.Q. necessary to obtain B standing is less than 75 for Grade IX. For Grade XII it appears to be 85, though the fact that the two lowest categories are not represented prevents drawing a definite conclusion. If one assumes that these students have dropped out of school because they found the work too hard, 85 can be accepted as the practical minimum I.Q.

Tables XVII to XX and the subsequent discussion

have been summarized in Table XXI, which shows the minimum I.Q.'s necessary for success in meeting the different criteria on the general averages for Grades IX and XII.

TABLE XXI. MINIMUM LAYCOCK MENTAL ABILITY TEST I.Q.'S NECESSARY TO MEET THE VARIOUS CRITERIA OF SUCCESS ON THE GENERAL AVERAGES OF THE EXAMINATIONS IN GRADES IX AND XII.

CRITERIA	MINIMUM I.Q.'S REQUIRED	
	GRADE IX	GRADE XII
H Standing (80 up)	95 - 105	105 - 115
A Standing or better (65 up)	90	95
University Entrance (60 up)	85	90
B Standing or better (50 up)	less than 75	85(?)

From Table XXI it appears that a student with a Laycock I.Q. not lower than 105 may hope, if he works effectively, to attain honors standing on the Grade XII examinations. Similarly, those with I.Q.'s of 90 or above may secure a standing at least equivalent to university entrance requirements. Those whose I.Q.'s are not lower than 85 may hope for a B standing.

However, Table XXII shows that the method of allocating the grades of H, A, and B nullifies to some extent the conclusions one might draw from Table XXI concerning the minimum I.Q. necessary to achieve a certain standing.

TABLE XXII. PERCENTAGE OF STUDENTS AWARDED GRADES OF H, A, AND B ON GRADE XII EXAMINATIONS COMPARED WITH THE PERCENTAGE OF STUDENTS POSSESSING THE MINIMUM OR HIGHER I.Q.'S NECESSARY FOR SECURING THOSE GRADES AS SHOWN IN TABLE XXI.

GRADE AWARDED	PER CENT OF STUDENTS	CUMULATIVE PER CENT	MINIMUM LAYCOCK I.Q. FOR GRADE (TABLE XXI)	PER CENT OF STUDENTS WITH NOT LESS THAN MINIMUM I.Q.		
				IX	XII ¹	XII ²
			115	33	48	54
H	5	5	105	57	81	86
.....						
A	20	25	95	80	95	97
.....						
B	35	60	85	94	99	100

1. Based on percentile distribution of students writing Grade XII English. (See Table VI)
2. Based on percentile distribution of students included in Grade XII academic general average. (Table VI)

It becomes clearly evident from Table XXII that the method of awarding the various grades according to the normal curve introduces a contradiction into the situation. For the group involved in this study, the minimum I.Q.'s for various levels of success were found through Tables XVII to XX and summarized in Table XXI. However, the percentage of students entering high school with at least these minimum I.Q.'s is much greater than the percentage to whom the corresponding grades are awarded. Because of the dropping out of students with low I.Q.'s, the disparity is much greater for Grade XII, especially for the group included in the general academic average.

If the test is valid - and this study shows it compares favorably in this connection with other group tests of intelligence - it appears that the ability represented by an I.Q. of 105 is sufficient to enable a student to secure Honors standing and all that such a standing signifies in the way of educational recognition and opportunity. This ability is possessed by approximately 57 per cent of Grade IX students and 86 per cent of those in Grade XII. H standing is awarded, however, to only 5 per cent of those writing the examination. It appears from Table XXII that the entire academic group in Grade XII possessed the

requisite ability as measured by the Laycock Mental ability Test, to secure B standing or better, yet this is awarded to only 60 per cent of the group. The dilemma posed by this table has significant implications for education which will be pursued more fully in Appendix C.

It does prevent the drawing of definite conclusions with respect to the minimum I.Q. necessary to achieving success at any level. As long as a certain grade is awarded to a fixed percentage of those writing the examination, it obviously cannot be earned by all of the very much larger percentage who appear to **possess** the necessary ability for that level of work no matter how effectively they strive. Therefore, one cannot safely say that a student with a Laycock I.Q. of 105, or even 115, can earn honors standing on the Grade XII examinations or that one with an I.Q. of 95 can achieve A standing. The minimum I.Q. essential to achieve a certain standing on the Grade XII examinations cannot, under the existing circumstances be established. It will vary with every general shift in achievement of the Grade XII students as a whole and appears to be related to both the general effectiveness of the schools and the nature of the examinations.

The same consideration qualifies, though not to

the same degree, the prediction of success for Groups I, II, and III as developed earlier. The probability of the success of any member of a group is related to the performance of the group of which he is a member, and it is on that basis that Tables XII and XIII were worked out. But the different criteria of success are also affected by the performance of the group. They are not determined in any absolute or independent fashion. Therefore, if the criteria change in any degree, the probable success of any group in relation to those criteria will also change.

An illustration may make this point clearer. If one were predicting the probability of a youth's attaining a height of 5 feet 11 inches at the age of 18 on the basis of the height of his parents, a sufficiently comprehensive study could supply the necessary data for saying: "If the average height of his parents is x inches, the probability is y in 100 that his height at 18 will be 5 feet 11 inches." If, however, for the height of 5 feet 11 inches, one substitutes a measure based upon the percentage of persons achieving that degree of tallness by the age of 18, and if through dietary deficiency or improvement the number reaching that height is changed, and if one then reduces or increases the measure to keep the

percentage constant, the basis of prediction becomes unstable.

Of course, if the trait under consideration is, in fact, distributed normally, and if the percentages we set are in accordance with normal distribution, such changes are not likely to occur.

It is clear, therefore, that the prediction of success must be done in tentative and general terms and with full knowledge of the possible variability of the criteria here suggested.

CHAPTER XI

CONCLUSIONS

Certain limitations must be kept in mind in drawing conclusions from this study. Several of them have been already referred to.

Starting with a Grade IX group and following it through high school resulted in having so few cases in many of the courses that definite conclusions respecting them cannot be drawn. The inadequate sampling in Grades X and XI prevent the drawing of any but the most tentative conclusions concerning these grades. The study made no attempt to determine whether or not the original group was typical of high school students in general, though there was considerable presumptive evidence to that effect. There were small numbers in the groups at each end of the distribution of I.Q.'s: so conclusions about their performance in relation to the differential criteria of success must not be drawn too rigidly. The failure to ascertain how many students actually enrolled in the academic program undoubtedly affects the accuracy of the estimate of the probability of success at the Grade XII level.

A further limitation should be noted. This was not a carefully controlled study in which the administration of the intelligence test was rigidly supervised and controlled. The test scores were taken from pupil record

cards after the students had left Grade IX. They may, therefore, be subject to errors arising from faulty administration of the test and inaccuracies in scoring, in calculating the I.Q.'s, and in entering them on the records. However, this limitation was accepted in advance for two reasons: the object of the study was to see how closely the results of the test as ordinarily administered relates to subsequent high school success, and it is tests administered in this way which furnish the basis for all, or nearly all, practical predictions by educational people.

Subject, then, to these limitations, certain conclusions previously presented in separate sections of the study can now be restated.

The study shows that there is a positive and significant relationship between Laycock Mental Ability Test I.Q.'s and marks on most of the academic subjects in the senior high school. The exceptions are Latin in Grades X, XI, and XII, French in Grade XI, and Chemistry in Grades XI and XII. The superior achievement of Group I, those with I.Q.'s above 120, as compared with Group III, those with I.Q.'s below 100, on the Grade XII examinations is evidence for the validity of the test. The correlations obtained are within the range of those quoted for similar studies.

These facts support the general conclusion that the Laycock Mental Ability Test is a reasonably valid measure of intelligence when compared with the criterion of marks in academic subjects.

The relationship between Laycock Mental Ability Test I.Q.'s and marks on non-academic subjects of the senior high school program was, in general, insignificant. Whether this lack of relationship results from defects in the test or from special factors related to the vocational and general subjects themselves we have insufficient evidence to decide. It does emphasize the limitations of a verbal test such as this as a measure of all aspects of intelligence.

The closer and more consistent relationship between I.Q.'s and English and social studies marks than between I.Q.'s and mathematics and science marks, especially in Grade XII, possibly gives further emphasis to this limitation. However, the differences in the populations involved prevent drawing any but a tentative conclusion. The validity of the test in relation to marks in general seems reasonably established. Further more rigorous analysis with regard to particulars appears desirable.

Prediction of success in academic subjects in high school on the basis of Laycock I.Q.'s may safely

be made for groups but not for individuals. The effect upon the prediction of a possible shift in the criterion must also be kept in mind. Even so, a fairly accurate estimate of the probable success of any of the three groups can be made, especially if it is limited to students in these schools and not extended to cover students of similar I.Q. from other areas.

Laycock I.Q.'s furnish little basis for predicting success in non-academic subjects except stenography.

Because of the nature of the criterion measures, it is not possible to determine the minimum Laycock I.Q. necessary to obtain a specified level of success in high school. It is true that minimum I.Q.'s were found in this study, but they are not generally applicable. They could, perhaps, be safely used in the schools represented in this study, but may not be generalized to apply to all Alberta students. Further studies would be required to show if they are consistent from year to year even for the included schools.

Until further studies corroborate these findings, it would be unwise to push any of these conclusions too far. They should be considered as tentative and provisional.

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APPENDIX A

SAMPLE OF THE FORM USED FOR RECORDING THE DATA

NAME: _____ BIRTHDATE: _____ GRADE FINISHED IX-X-XI-XIIa-XIib-Male ----- Female

McCock M.A.T.				Otis Gamma			IX X XI XIIa XIIb					
Year	Score	M.A.	I.Q.	Year	Score	I.Q.	Year Completed					
							C.A. (Months)					
							M.A.T. MA (Months)					

GRADE IX MARKS		HIGH SCHOOL MARKS ACADEMIC AND COMPULSORY				VOCATIONAL AND GENERAL					
Subject		Subject	X	XI	XIIa	XIib	Subject	X	XI	XIIa	XIib
Eng. Lang.		English	1	2	3		General Math	1	2	3	
Eng. Liter.				Liter			General Sc.				
Soc. Studies		Soc. Studies					Average Math-Sc.				
French		French					Typewriting	1	2		
Latin		Latin					Stenography				
Average							Bookkeeping			3	
Language							Business Machines			1	
Manities							Office Practice		1	2	
General Math		Algebra	1		2		Secretarial Trg.			1	
		Geometry		1			Average Commercial				
		Trigonometry & An. Geom.					Arts and Crafts	1	2	3	
General Science		Physics	1		2		Automotives				
		Chemistry		1	2		Electricity				
		Biology			2		Fabrics and Dress				
Average							Homemaking				
Math and Sc.							Metalwork				
General					one year	2nd year	Printing				
Average					1st year	2nd year	Woodwork				

APPENDIX B

SOME IMPLICATIONS FOR GUIDANCE

It cannot be too strongly emphasized that this study - and every similar study - concerns the validation of a particular test in relation to some specific criterion measure. Conclusions that go beyond the data of a study are likely to be misleading where they are not entirely false.

This fact, that, as Bennet says, validation is always specific and never general, compels the school user or, for that matter, any user of an intelligence test to determine how closely it relates to the relevant criteria or criterion in his case. The fact that the test was carefully validated originally does not mitigate the compulsion. The criteria against which it was validated may not apply with the same force they had when the test was prepared, or they may not be the same as those against which the test should be validated at the time of use. Items which at one time had high discriminating power may have lost it because of social change. The population on which the test was standardized may not be strictly comparable to the population on which it is now being used. Other tests of a similar nature may have been used successfully for the type of prediction desired, but the test user may not, therefore, say that the test he is using will be a satisfactory

basis for making similar predictions.

Nevertheless, one hears all too frequently remarks like this. "He has an I.Q. of only 100; he can't possibly finish high school," or this: "He should not try an academic program; his I.Q. is only 105." Pronouncements like these, and even more drastic ones are being made continually by some teachers and counsellors on the basis of some intelligence test, although they have no actual supporting data relative to their own situations.

To such persons the I.Q. has ceased to be a score obtained upon a certain test and, therefore, subject to all the limitations and weaknesses of the test itself. It tends to assume a sort of mystical, absolute, and arbitrary power, something like that of the heavenly bodies to an astrologist; once it is discovered it rules omnipotent. This is particularly so when the I.Q. appears in all its mystic significance neatly inscribed on the student's record card. The importance of studies such as this is that they serve to remind the reader that the significance of any test is the closeness of its relationship to a specific set of circumstances or requirements.

Some of the concepts of measurement in the physical sciences with its rigidly standardized

units have been taken over by the psychologically naive into the field of psychological testing. A height of 72 inches properly measured on one scale will also be a height of 72 inches when properly measured on another, within, of course, the margin of experimental error. The equality of units is a fundamental concept in measurement. The I.Q., however, is a derived score, twice derived in most instances, mental ages being assigned to raw scores and the I.Q.'s computed from these mental ages. Each item in the Laycock Test, for example, is given a raw score value of one, but the items themselves are different, and the decision to make them of equal value is a purely arbitrary one. Other tests are constructed similarly with scores, weighted or otherwise, assigned in accordance with the theories held by the test constructor. In spite of this, there is a strong tendency to regard an I.Q. of 100 as though it were made up of 100 I.Q. points in the same way that a measurement of 72 inches is made up of 72 separate, equal, and interchangeable inches. On this basis, many persons wrongly assume that an I.Q. of 100 obtained on Test A equals an I.Q. of 100 on Test B. An even more dangerous and far easier assumption is that equal I.Q.'s on Test A for two or more persons represent equal, almost identical intellect-

ual ability. The I.Q. is a sort of average measure and, like all averages, it obscures the constellation of factors it represents. The assumption that because averages are equal the patterns they represent are identical is quite untenable.

Bennett's remark, previously quoted, deserves re-emphasis: "There is no general 'validity of a test' only empirical 'validities'." (1) Much bad guidance would be avoided if all school counsellors remembered this and remembered, too, that even in the most accurate measurement in physical science "some degree of experimental error is always present". Psychological measurements can never be as accurate as measurements in the physical sciences; but too many teachers and counsellors treat them as though they were. Moreover, in this study, as in all similar studies, statistical methods have been applied to large groups. The great variability among individuals requires that conclusions derived from such studies should never be rigidly applied to individuals. It is always a case of "the probability is....." or "the chances are....."

APPENDIX C

IMPLICATIONS FOR EDUCATION

Table XVII shows that the two highest I.Q. groups achieved no better than the lowest groups with respect to the criterion of Honors Standing. Except in English and biology none of these students achieved at the level to be expected from their I.Q.'s. It is a rather sobering thought that a student may fail to achieve in high school at a high level of success if he possesses too much intelligence as easily as if he possesses too little. As there were only four students in the two top groups, it is evident that a much more comprehensive study would be needed to establish the truth of such a statement. If it were established it would raise the question of the optimum I.Q. for success in high school, a rather interesting and challenging problem, which may not be as remote from actuality as it appears at first glance. It may well be that our schools do not serve effectively the two extremes but concentrate their efforts upon the average group.

Another point emerging from this study deserves further consideration. The comparison of the percentages of students awarded certain grades and the percentages of those apparently possessing the requisite ability

to earn those grades was given in Table XXII. It appears from this table that 97 per cent of students in Grade XII are theoretically in competition for gradings allocated to only 25 per cent of them and that approximately 86 per cent compete for the grading awarded to only 5 per cent. Even if we raise the minimum I.Q. necessary to obtain Honors standing in Grade XII to 115, which Table XVII shows to be more appropriate, we are still faced with the fact that 54 per cent of students possess the necessary ability to meet this criterion and are, therefore, in competition for the grade allotted to only 5 per cent of them.

This situation makes it difficult, if not impossible, to present this information honestly to students in counselling situations because, if counselling were completely effective and all students were thereby stimulated to apply their abilities with complete efficiency to their studies, their improved performance need not result in any improvement in their grades. It would be different if a well standardized and very comprehensive achievement test battery were used in place of the present examination and if definite raw scores rather than percentiles were used as the various cut-off points. If percentiles were used, every change in general achievement would be reflected in changes in the scores they represent so that the general situation

with regard to the awarding of grades would be much as before. Theoretically it would be possible to have a system one hundred per cent efficient wherein every student, even the poorest, received a very thorough and sound education and still fifteen per cent of them would receive failing grades.

Improvement in relative position is possible because it is usually an individual or local matter. One student in a class decides to work more effectively, or one school improves its techniques and its results. If the whole class decides to improve at the same time, and does so, there is likely to be little change in the relative standing of individuals within the group except as the previous differences between ability and achievement varied; some students might have a greater difference to make up than others. Similarly individual schools may greatly increase the proportion of their students obtaining H or A standing only because they increase their effectiveness relative to other schools in the province.

The assumption underlying this system of grading seems to be that no matter how effectively the work is done a considerable number of students will deserve the distinction of honors standing and a larger number will require to be failed. This may have some practical

merits at present, but does not seem to be logically defensible unless one admits that achievement in school subjects at the Grade XII level must be distributed in accordance with the normal curve. This necessity has not yet been demonstrated as far as the writer is aware. Indeed, the selective factors operating during high school suggest, at least, that the application of this principle is inappropriate. The method seems to accompany a feeling that it is impossible to devise a test on which some score will represent a suitable standard to determine admission to the next higher level.

When the final tabulation has been made of the examinations for any year, one can never be sure whether the performance of the students was inferior or superior to their performance in other years. Consequently, one can come to no valid conclusions concerning the general effectiveness of the schools.

It should be possible to analyse the requirements of succeeding courses and to devise measures which will show whether or not a student can meet them successfully. Perhaps a more careful item analysis is needed. Perhaps an entirely new type of test. One does not expect a rigid and exact "Go" and "No-Go" gauge, but something of the sort should be within the limits

of possibility.

There is a wide demand for improvement in the efficiency of our schools, presumably through better teaching, more effective counselling, better study and work habits on the part of students, more intelligent co-operation by parents, and a return to the "older and better" type of curriculum. Of what value will this be to students generally if, under the tyranny of the normal curve, we continue to fail the same fixed percentage of much better prepared students? The way out of this dilemma is not to return to the old type of examination and an arbitrary pass mark but to develop newer measuring instruments more closely related to the requirements of higher levels of training and to discover what point or points on these scales must be reached as the necessary prerequisite of success.

Apparently these measurements would require some appraisal of intelligence and aptitudes, information in certain areas, emotional stability, interest patterns, motivation, social participation, and general maturity. The fact that devising such a measure is extremely difficult does not absolve the Department of Education and the University from blame for their failure to do more in the way of attempting to devise it. Certain

members of the faculty of the University have pleaded for a return to an absolute standard but they have failed to show how such a standard, to be valid and defensible, can be set up. Certainly it cannot be, as some imply, merely a measure of what a student remembers of a particular course or of particular courses at examination time.

The use of the present method of defining grades awarded on the examinations leaves unanswered the question: "Are our schools, in fact, efficient?" (I use the word in the broad sense to cover far more than a knowledge of subject matter, though that is an extremely important factor in their total efficiency.) But a return to the old type examination with a set pass mark, the absolute standard beloved by some, would also leave it unanswered, for such an examination never measured more than a segment of a segment of the student's preparation for and ability to meet future requirements, and in actual practice has been proven to be grossly unreliable. (8, 9, 15, 17, 22)

It is possible that a properly constructed and very comprehensive achievement test combined with a valid measure of general intelligence could yield scores which would be highly predictive of success in further training. A combined score on such a

battery might be definitely established as the minimum requirement. If such a measure could be devised, we would have an absolute standard that would have some meaning and validity. The possibility is an interesting one.

There is little doubt that instruction in our schools could be vastly improved. It is certain that more skilful handling by teachers and parents could improve the performance and achievement of students. It is an interesting speculation to envisage this as taking place simultaneously all over the province so that even the failures would be quite well trained though, of course, not to the level of the best. Would we then continue to use our present system of awarding grades, or would we accept the fact that at last we had reached an educational Utopia where, in actuality, all students were successful. Like all Utopias, this one is a long way off.

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